

Claims

1. An instrument for cleaning and/or shaping and/or widening a channel that exists in or through a solid object;  
wherein at least of portion of the body of said instrument is comprised of  
5 longitudinal elements and circumferential elements that connect adjacent longitudinal elements, thereby defining the three dimensional shape of said portion of said body, such shape being an empty volume surrounding the longitudinal axis, said volume bounded radially by a wall having an open lattice-like structure, and wherein the design of said  
10 instrument and the material from which it is made allows said volume, the outer contour of said instrument, or both to change during use in order to shape said instrument to the three dimensional contour of said channel.
  
- 15 2. An instrument according to claim 1, wherein the design of said instrument and the material of which said instrument is made allows the outer contour of said instrument to change during use to conform to the perimeter of the local cross section of the channel at any radial plane located along the length of said instrument that is  
20 inserted into said channel.
  
3. An instrument according to claim 1, wherein said instrument is made from a superelastic material.

4. An instrument according to claim 1, wherein said instrument is made from material having shape memory properties.
5. An instrument according to claim 4, wherein the material of which said instrument is treated after said instrument is produced to give it shape memory properties.
6. An instrument according to claim 3, wherein the superelastic material is a nickel titanium alloy.

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7. An instrument according to claim 4, wherein the instrument having shape memory properties is made from a nickel titanium alloy.
- 15 8. An instrument according to claim 1, wherein the design of said instrument and the material of which said instrument is made allows a single instrument to be inserted into the channel and used for the entire procedure of cleaning and/or shaping and/or widening said channel before being withdrawn.

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9. An instrument according to claim 1, wherein, if said instrument breaks inside the channel, a specially designed extractor is used to

withdraw the broken piece of said instrument from said channel without causing damage to the solid object.

10. An instrument according to claim 1, wherein the three-dimensional  
5 shape of the longitudinal and circumferential elements is chosen

from the group comprising:

- blade shaped;
- polygonal prism shaped;
- rod shaped;
- 10 - curved shaped; and
- round shaped.

11. An instrument according to claim 1, wherein the longitudinal and  
circumferential elements have a cross-sectional shape chosen from

15 the group comprising:

- polygonal;
- round;
- curved; and
- blade-shaped.

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12. An instrument according to claim 1, wherein the longitudinal  
elements have a shape selected from the group comprising:

- straight elements; and

- curved elements.

13. An instrument according to claim 1, wherein the circumferential elements have a shape selected from the group comprising:

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- straight elements; and
- curved elements.

14. An instrument according to claim 1, wherein at least a part of the outer surface of said instrument is constructed or modified in one of the ways selected from the following group:

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- a. at least part of the outer surface of said instrument is coated with a coating of a abrasive material;
- b. at least part of the outer surface of said instrument is roughened;

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- c. at least part of the outer surface of said instrument comprises numerous small teeth; and,
- d. at least part of the outer surface of said instrument comprises a cutting edge;

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thereby allowing said instrument to remove material from the wall of the channel when relative motion takes place between said outer surface and said wall.

15. An instrument according to claim 14, wherein the abrasive material is chosen from the group comprising:

- diamond powder;
- titanium nitride; and
- 5 - tungsten carbide.

16. An instrument according to claim 14, wherein the relative motion is chosen from the group comprising:

- rotation;
- 10 - translation;
- vibration; and
- a combination of two or more of these motions.

17. An instrument according to claim 1, wherein debris resulting from the cleaning and/or shaping and/or widening can be removed from the channel while said instrument is inserted and working in said channel as a result of one or both of the following features of the design of said instrument:

- a. said instrument is designed such as to have a hollow interior through which said debris may be withdrawn; and,
- 20 b. said instrument is designed such as to have at least some of the circumferential elements project radially outward from the

longitudinal elements, thereby creating a space through which said debris may be withdrawn.

18. An instrument according to claim 17, wherein fluid can flow into the  
5 channel through one or both of:

- a. via the interior of said instrument; and,
- b. via the space between the wall of the channel and the outer surface of said instrument;

while said instrument is inserted and working in said channel.

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19. An instrument according to claim 1, wherein, during the procedure of cleaning and/or shaping and/or widening the channel, a relatively uniform amount of material is removable from the wall of said channel along the entire insertion length of said instrument in said channel.

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20. An instrument according to claim 1, wherein, during the procedure of cleaning and/or shaping and/or widening the channel, a different amount of material is removable from the wall of said channel at different positions along the insertion length of said instrument in said channel

21. An instrument according to claim 1, wherein the material of which said instrument is made allows said instrument to be inserted into the channel such that it passes through the entire length of said channel.

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22. An instrument according to claim 1, wherein said instrument is inserted into the channel such that it passes through only a portion of the entire length of said channel.

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23. An instrument according to claim 1, wherein, as a result of the design of said instrument and the material of which said instrument is made the cross-sectional shape of said channel, along the entire insertion length of said instrument that is inserted into said channel, is essentially the same after the procedure of cleaning and/or shaping and/or widening the channel as before said procedure.

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24. An instrument for cleaning and/or shaping and/or widening a channel that exists in or through a solid object, wherein said instrument comprises a long narrow balloon, which is inserted into said channel and then inflated.

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25. An instrument for cleaning and/or shaping and/or widening a channel that exists in or through a solid object, wherein the body of said instrument is comprised of one longitudinal element from which project radially a multitude of elements, wherein said instrument is made from one or both of the following:

- a. a superelastic material; and,
- b. a material having shape memory properties;

thereby allowing the outer contour of said instrument to change during use in order to shape said instrument to the changing three dimensional contour of said channel.

26. An instrument according to claim 25, wherein said elements are selected from the following group:

- a. blade-like; and,
- b. wire-like.

27. An instrument according to claim 1, wherein said instrument is an endodontic file, the channel is a root canal, and cleaning and/or shaping and/or widening of the channel comprises the cleaning, shaping, and widening stage of a root canal procedure.

28. A method of using the instrument of claim 1 for cleaning and/or shaping and/or widening a channel that exists in or through a solid object said method comprising the following steps:

- inserting said instrument into said channel;
- 5 - causing relative motion between said instrument and the wall of said channel;
- optionally, removing the debris resulting from said cleaning and/or shaping and/or widening from said channel while said relative motion between said instrument and said wall of said channel takes place;
- 10 - optionally, causing fluid to flow into said channel while said relative motion between said instrument and said wall of said channel takes place; and
- removing said instrument from said channel when said cleaning and/or shaping and/or widening have been completed.

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29. A method of using the endodontic file of claim 27 for cleaning, and/or shaping, and/or widening a root canal, said method comprising the following steps:

- 20 - inserting said file into said root canal;
- causing said file to move relative to the wall of said root canal;

- optionally, removing the debris resulting from said cleaning, shaping, and widening from said root canal while said file moves relative to said wall of said root canal;
- optionally, causing fluid to flow into said root canal while said file moves relative to said walls of said root canal; and
- removing said file from said root canal when said cleaning, shaping, and widening have been completed.

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30. A method according to claim 28, wherein more than one file is used  
10 to clean, and/or shape, and/or widen the channel.

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31. A method according to claim 29, wherein more than one file is used  
to clean, and/or shape, and/or widen the channel.

**Abstract**

The invention is an instrument for cleaning and/or shaping and/or widening a channel that exists in or through a solid object. The design of the instrument the superelastic and shape memory properties of the material from which it is made, allow the inner volume enclosed by the instrument, its outer contour, or both to change as a result of the forces exerted upon it while working, thereby shaping the instrument to the three-dimensional contour of the channel. A preferred embodiment of the instrument is an endodontic file for use in the cleaning, shaping, and widening stages of a root canal procedure.

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